Controlling the Part

- Static Bits
- Serial and Parallel Interfaces
- Starting up the Part
- Changing States
- Waiting for the Part

DB Lines

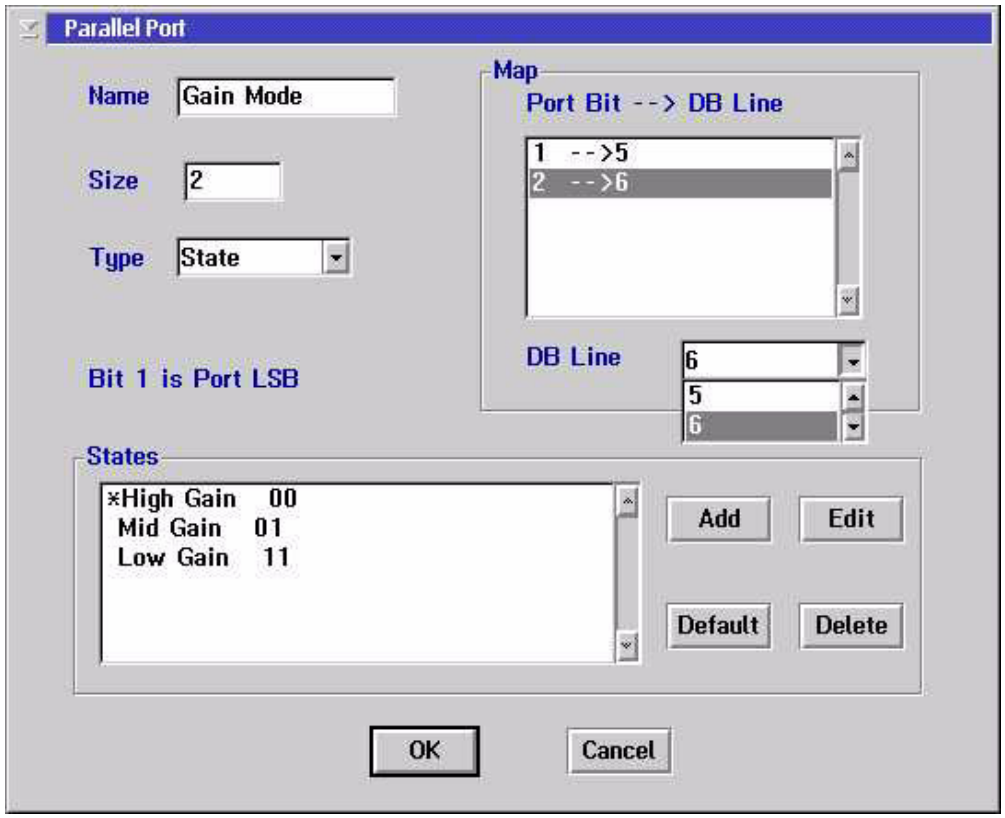
- Static digital control
- Serial bus
- Parallel bus
- Leakage (low current) measurements
- ESD diode check (force current)

Serial/Parallel Bus Control

- DUT Defined or "Brute Force"
- DUT Defined Contained in Dut Instrument
- Single Button Programming
- Allows Descriptive Names
- DUT buttons created

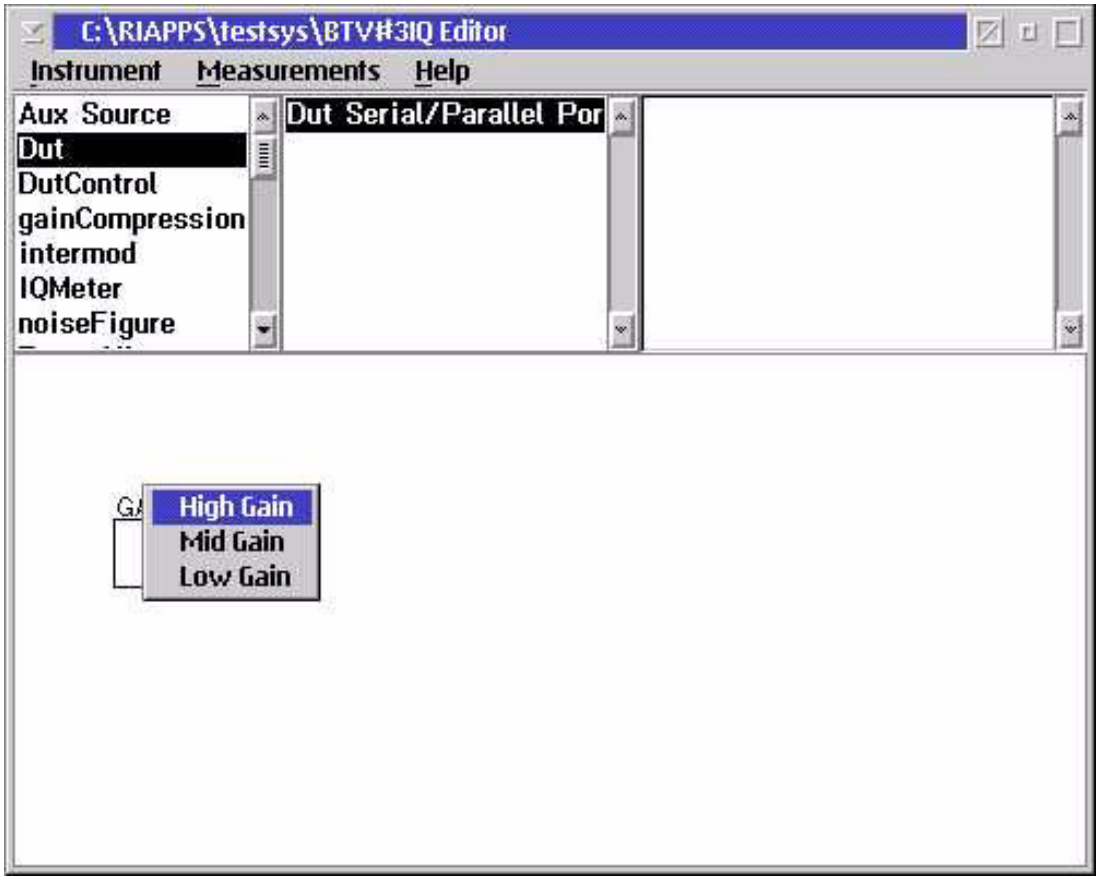
Parallel Bus

- Establish Port Size
- Set Type to State
- Map DUT pin to DB line
- Add States
- Establish Default State

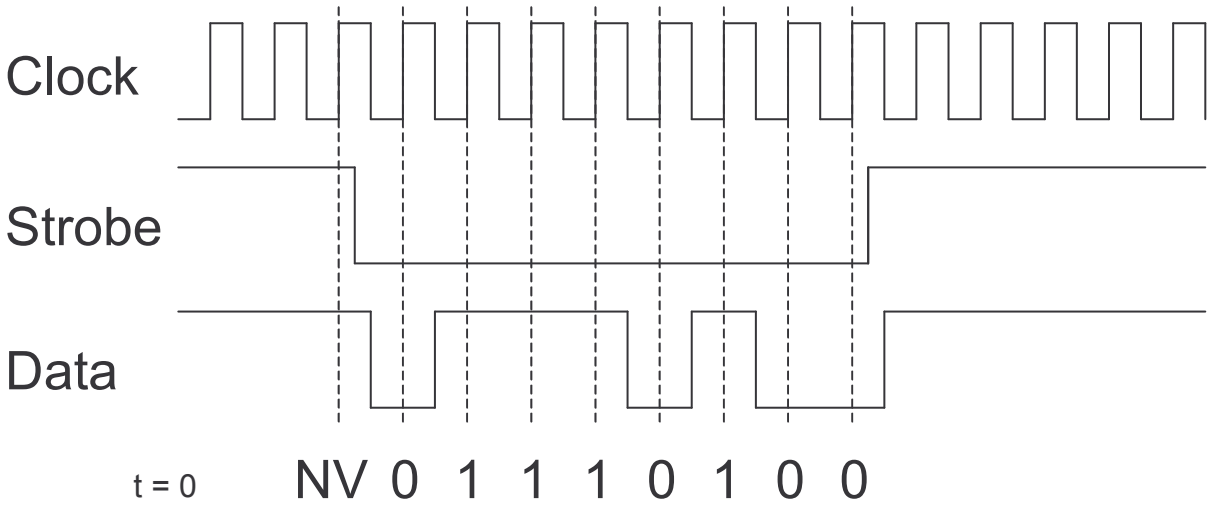


Dut Parallel Port

- Dut Object Created
- Put in Test Plan



Serial Port Basics

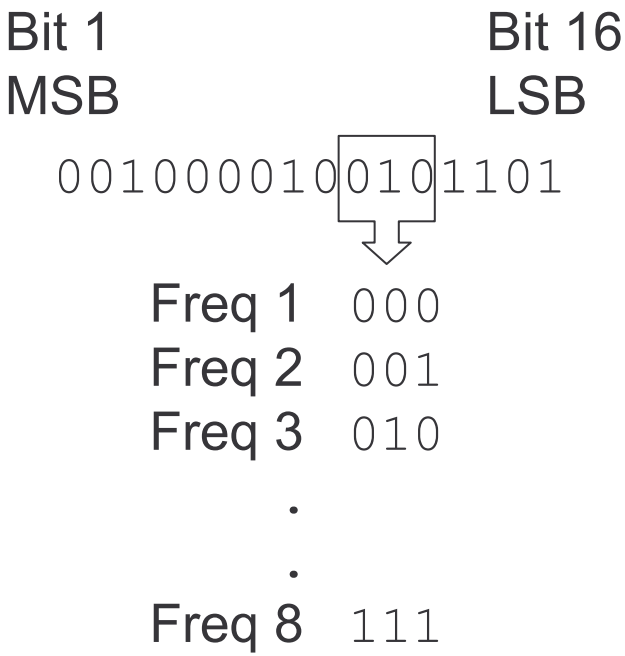


Data: MSB First
Clock: Positive
Strobe: Negative, Long

Data: 01110100 Binary
116 Integer

Serial Port Basics Fields

- 16 Bit Bus
- Frequency Field
- 1st Bit: Bit 10
- Size: 3 Bits
- 8 Potential States



RI Serial Definitions

- Bit order 1 thru N (no bit 0)
- Bit 1 is MSB
- Bit 1/MSB is on Left

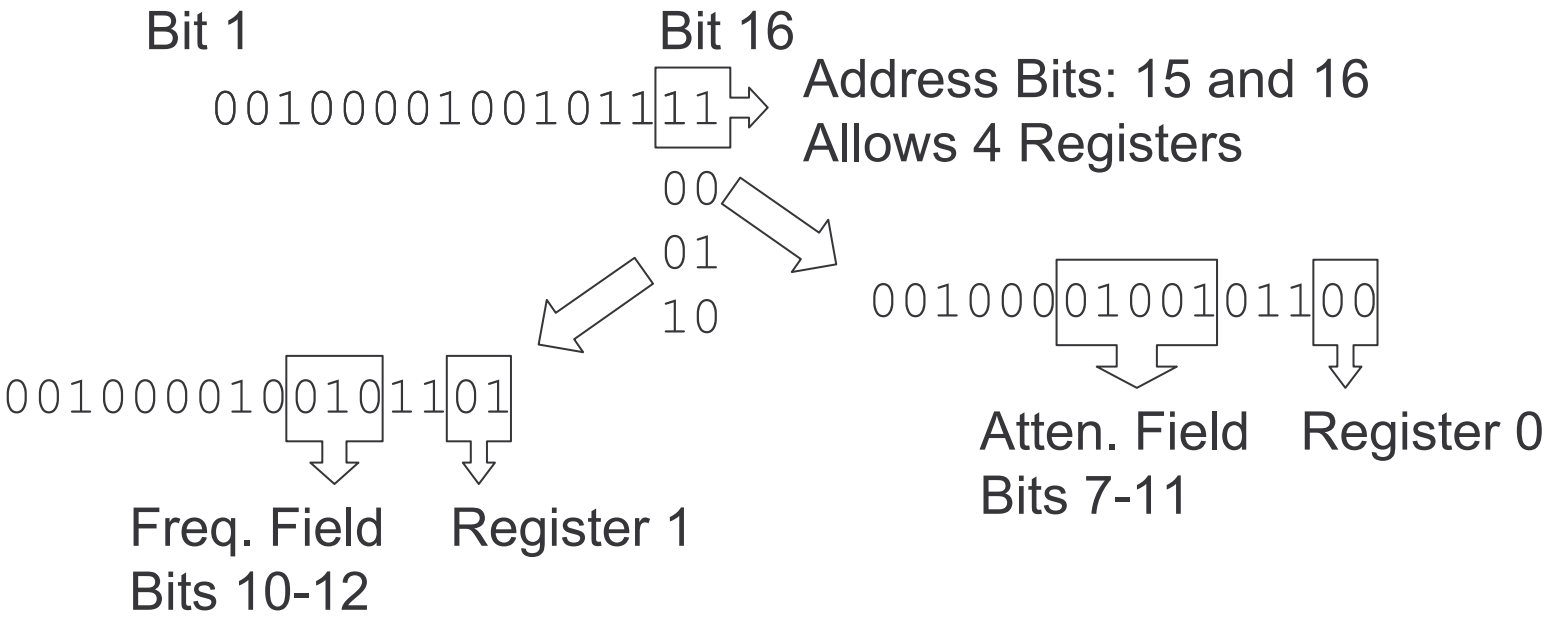
Bit 1	Bit 16
MSB	LSB

0010000100101101

Serial Port Basics
Registers

- Serial Bus can be Multiplexed into Registers
- Bits are Allocated to Register "Address"
- Specific Address Changes Field Definition
- Allows Expansion of Serial Capability

Serial Port Basics
Registers



Programming Serial Port

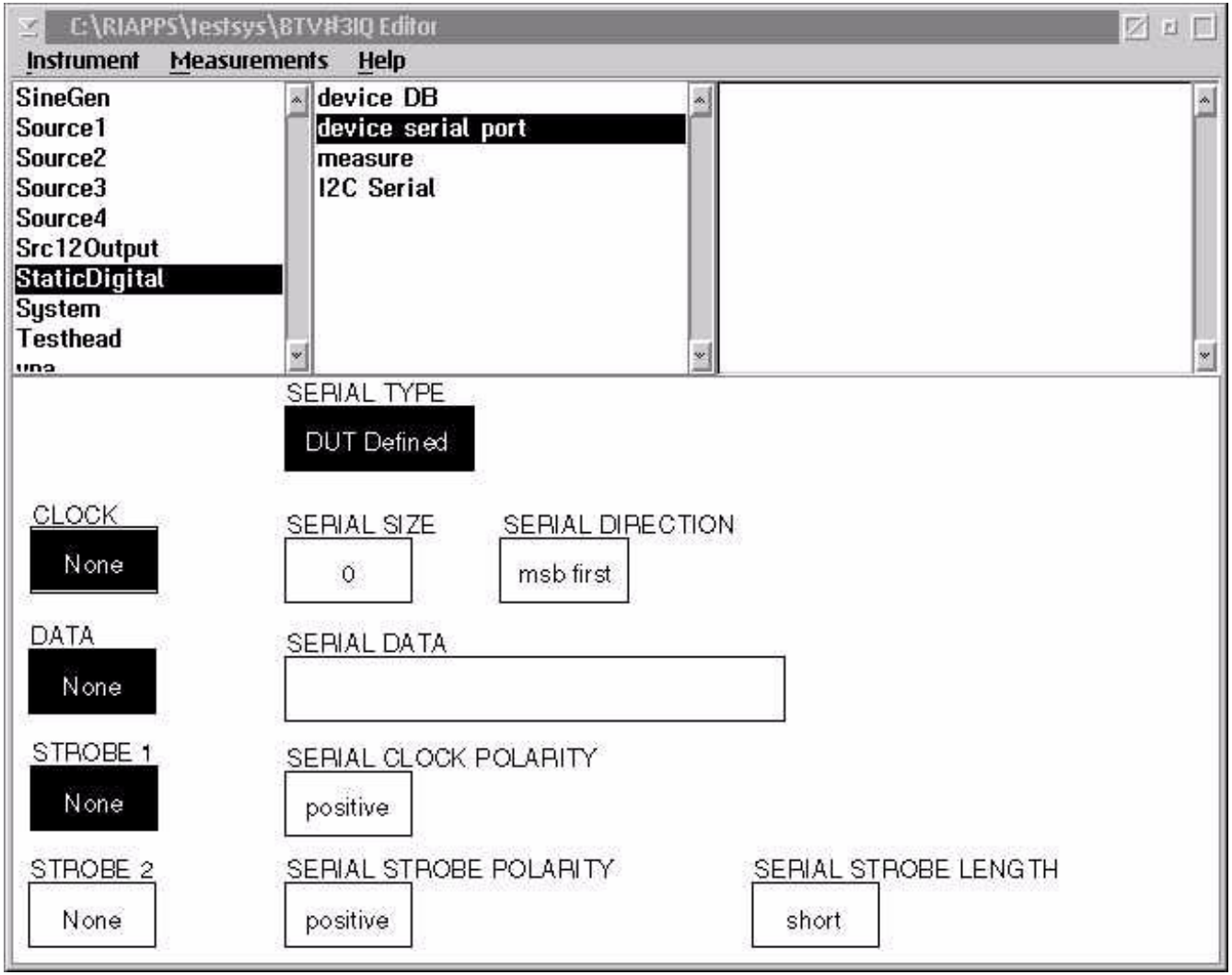
- Select Serial Type
  - Dut Defined/Local/I2C/I3C
- Assign Static Digital Resources
  - Clock
  - Data
  - Strobe
- Define Dut

Fast Serial Control

- Standard Serial: 60 KB/Second
- Fast Serial: Up to 2.5 MB/Second
  Fast I2C: Up to 600 KB/Second
- Specific Digital Resources
  - Read: DB 1 or 9, Write: DB 2 or 10
  - Clock; DB 3 or 11
  - Must be adjacent
- New "Serial Clock Period" Button

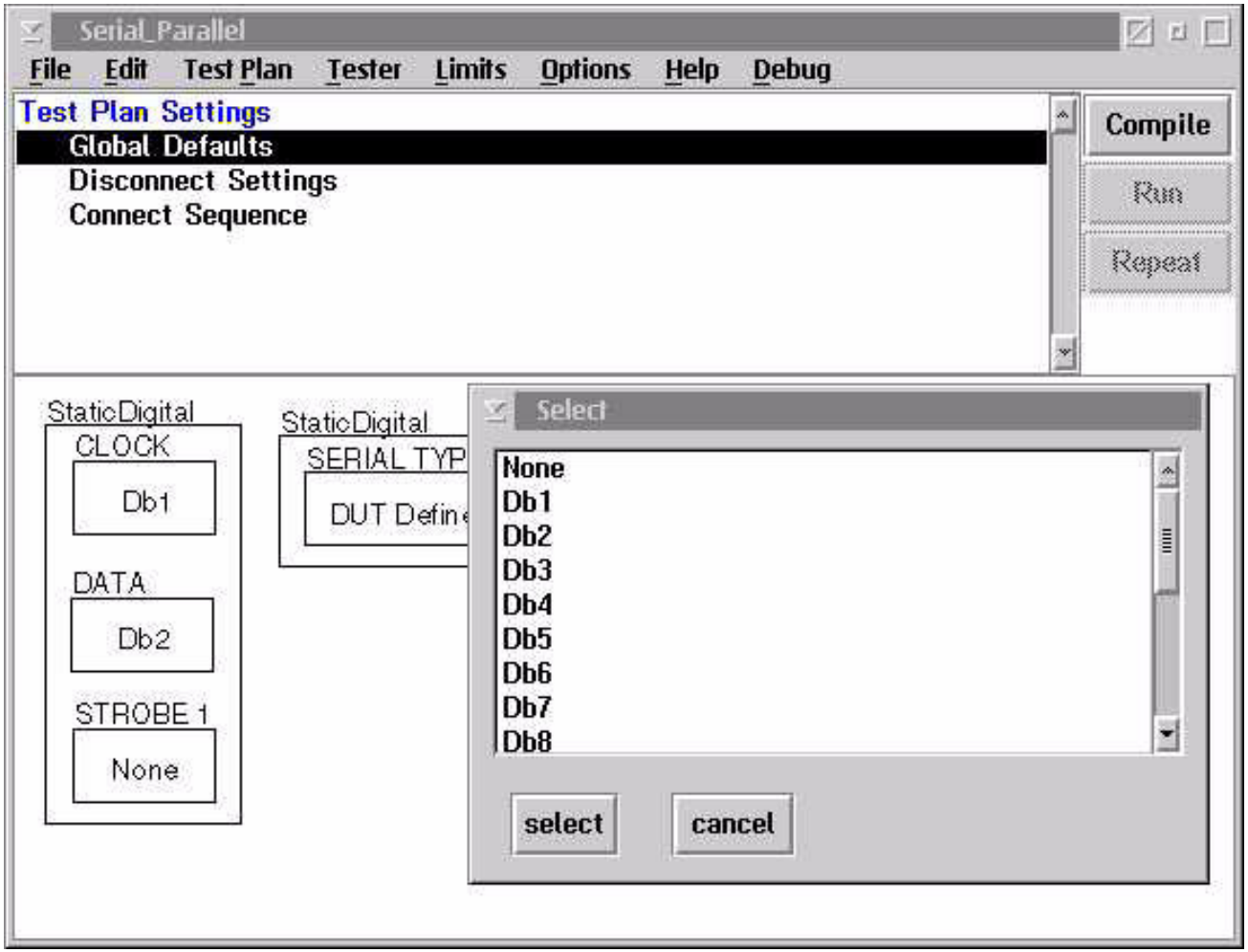
Static Digital Resources

- Type
- Read
- Clock
- Data
- Strobe



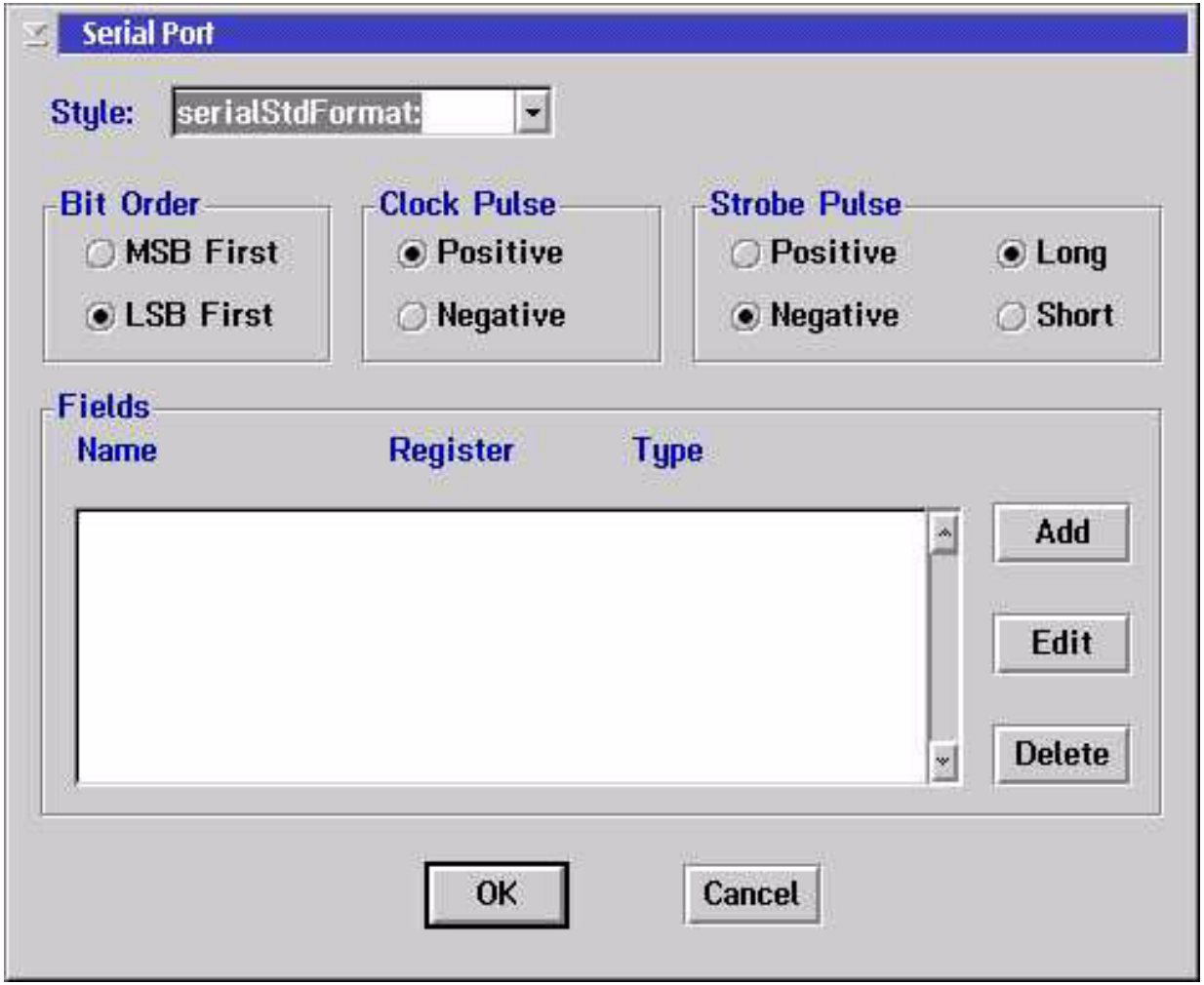
Static Digital Resources

- Assign DB Lines



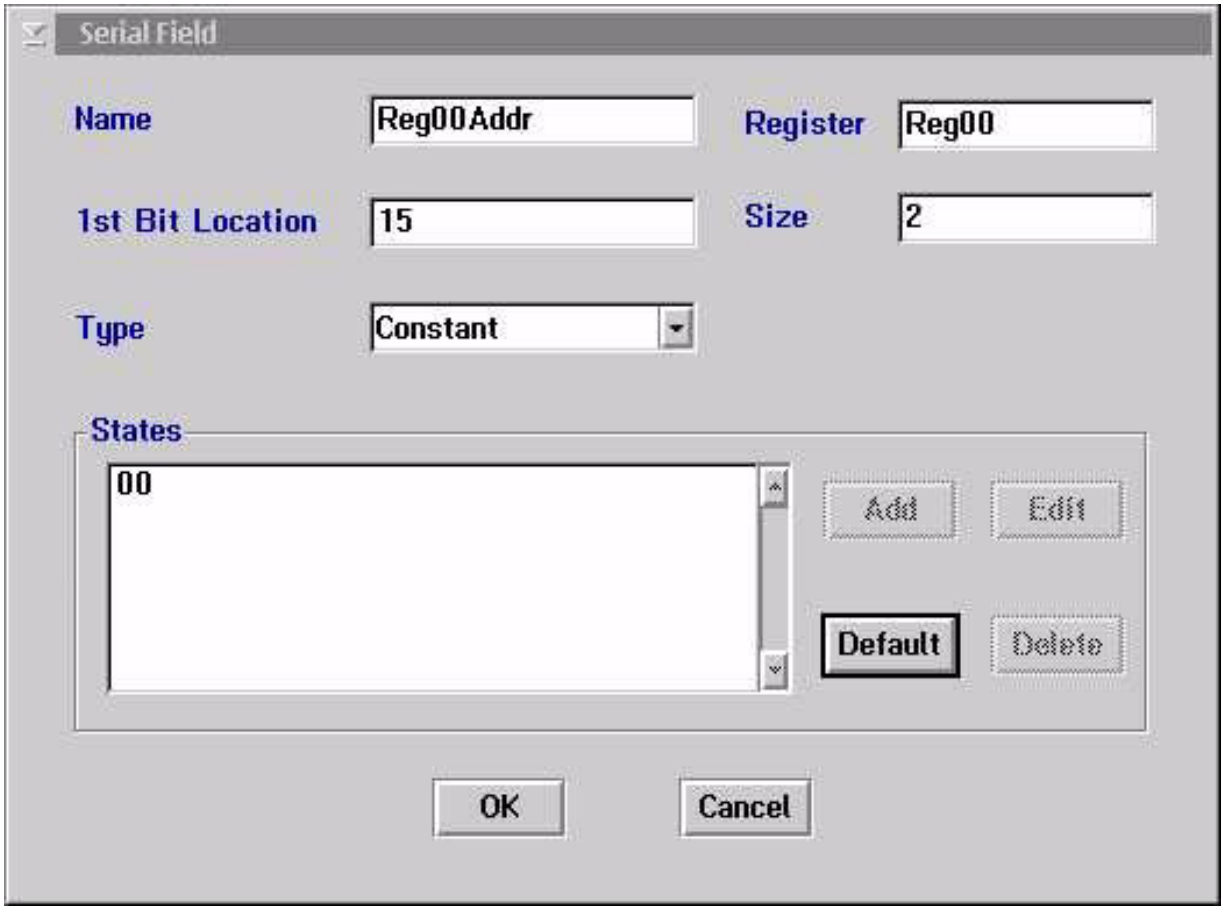
Dut Definition

- Style
- Bit Order
- Clock
- Strobe Pulse
- Strobe Length



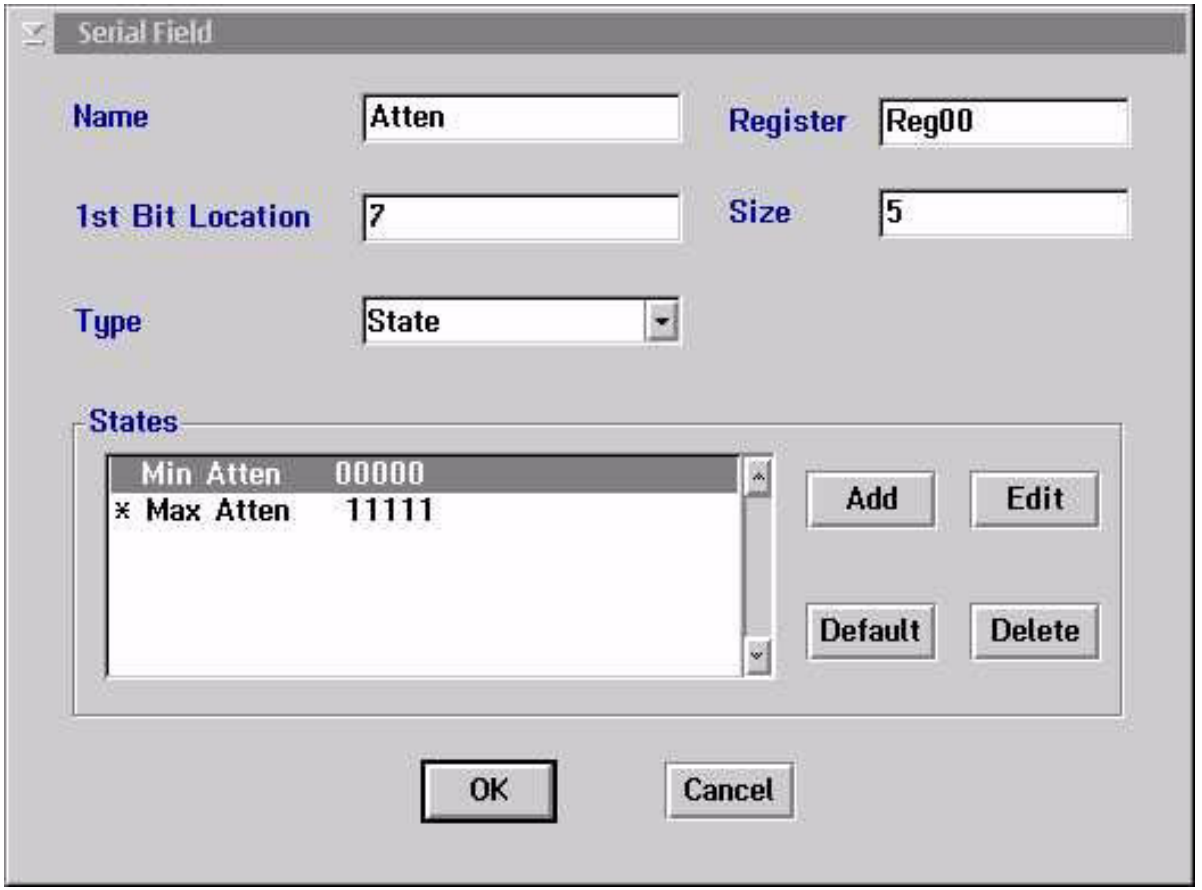
Register Addressing

- Register: Reg00
- Type: Constant
- Bits 15 and 16



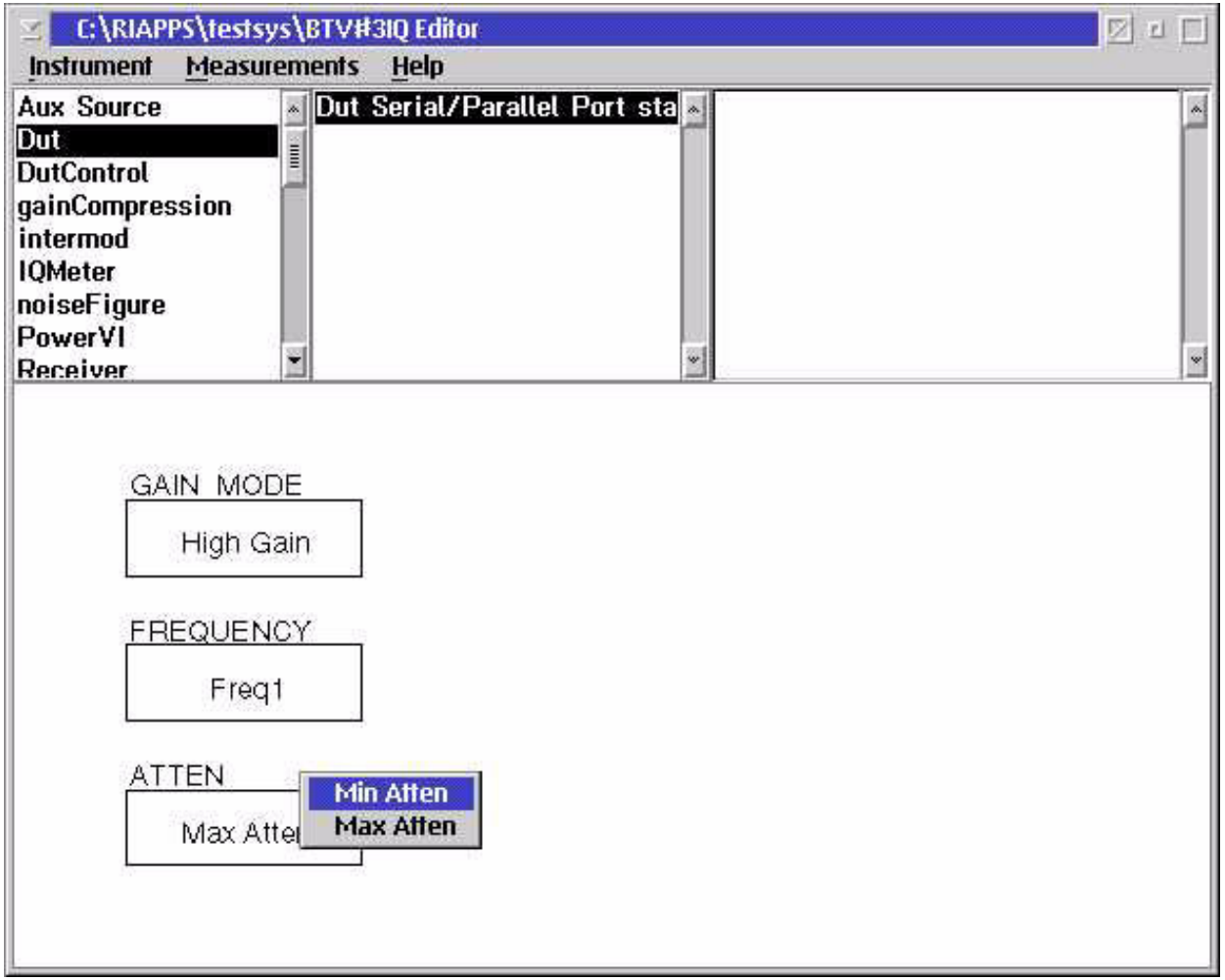
Fields in a Register

- Reg00 Links to Register 0
- Field: Starts Bit 7, 5 bits Wide
- Type: State
- Add States w/Bits
- Set Default



DUT Serial Port

- DUT Created
- Put in Test Plan

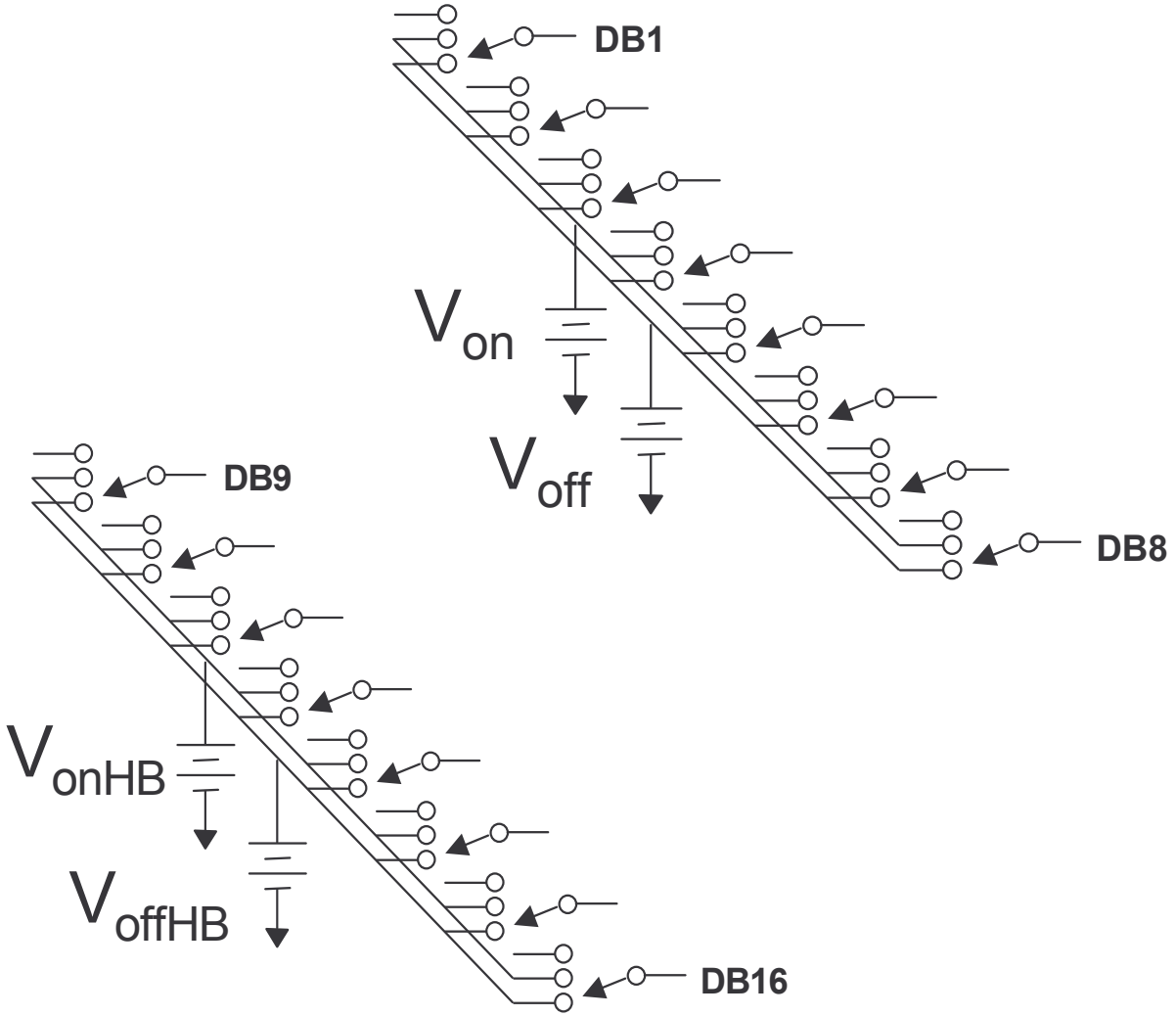


ROOS INSTRUMENTS

DB Lines Description

- Switch between Von. Voff, Open
- 16 lines, 2 banks
- 4 voltage supplies
- 1 Precision Multimeter
- 2 mA limit
- +/- 10V

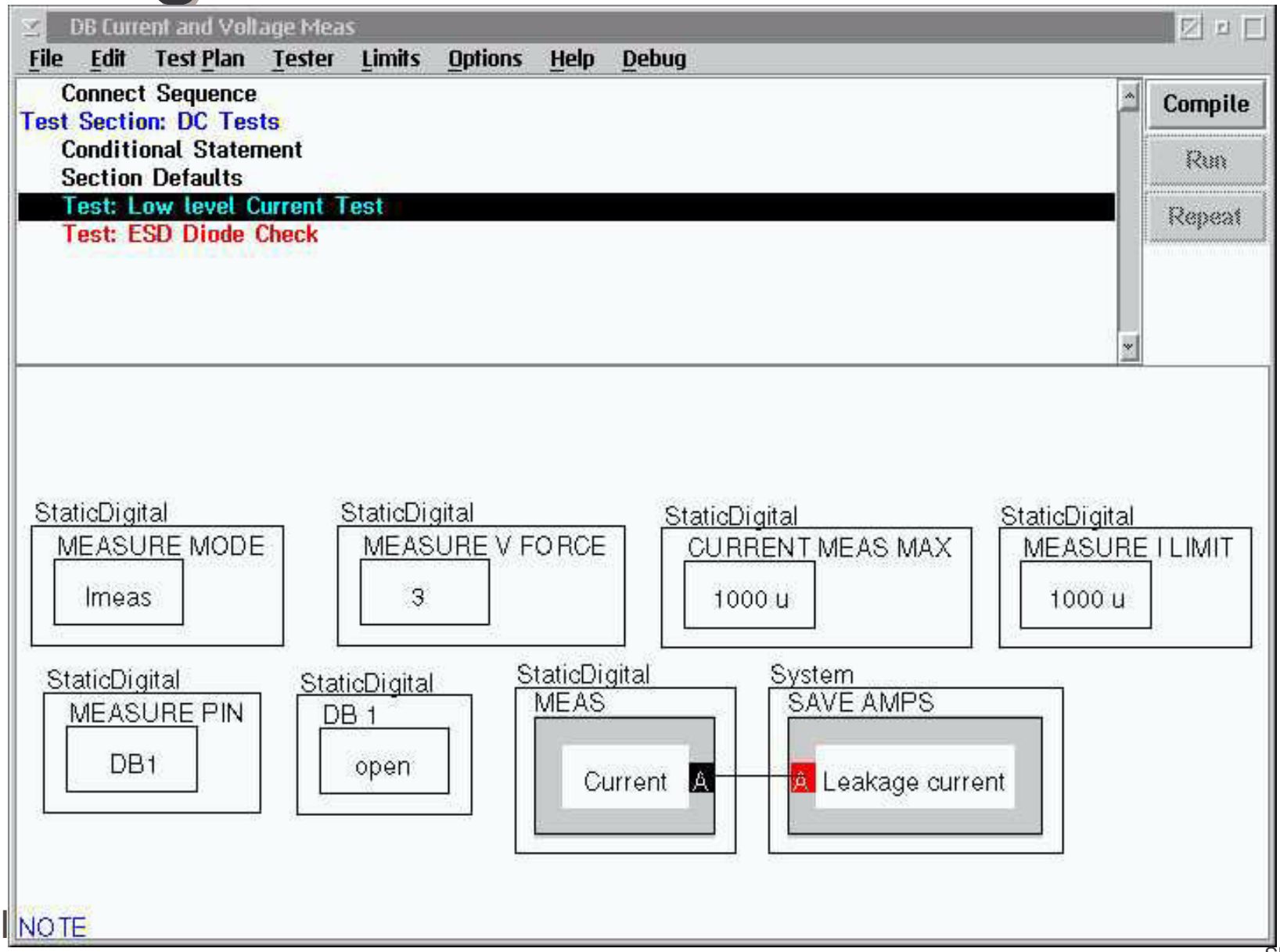
Schematic



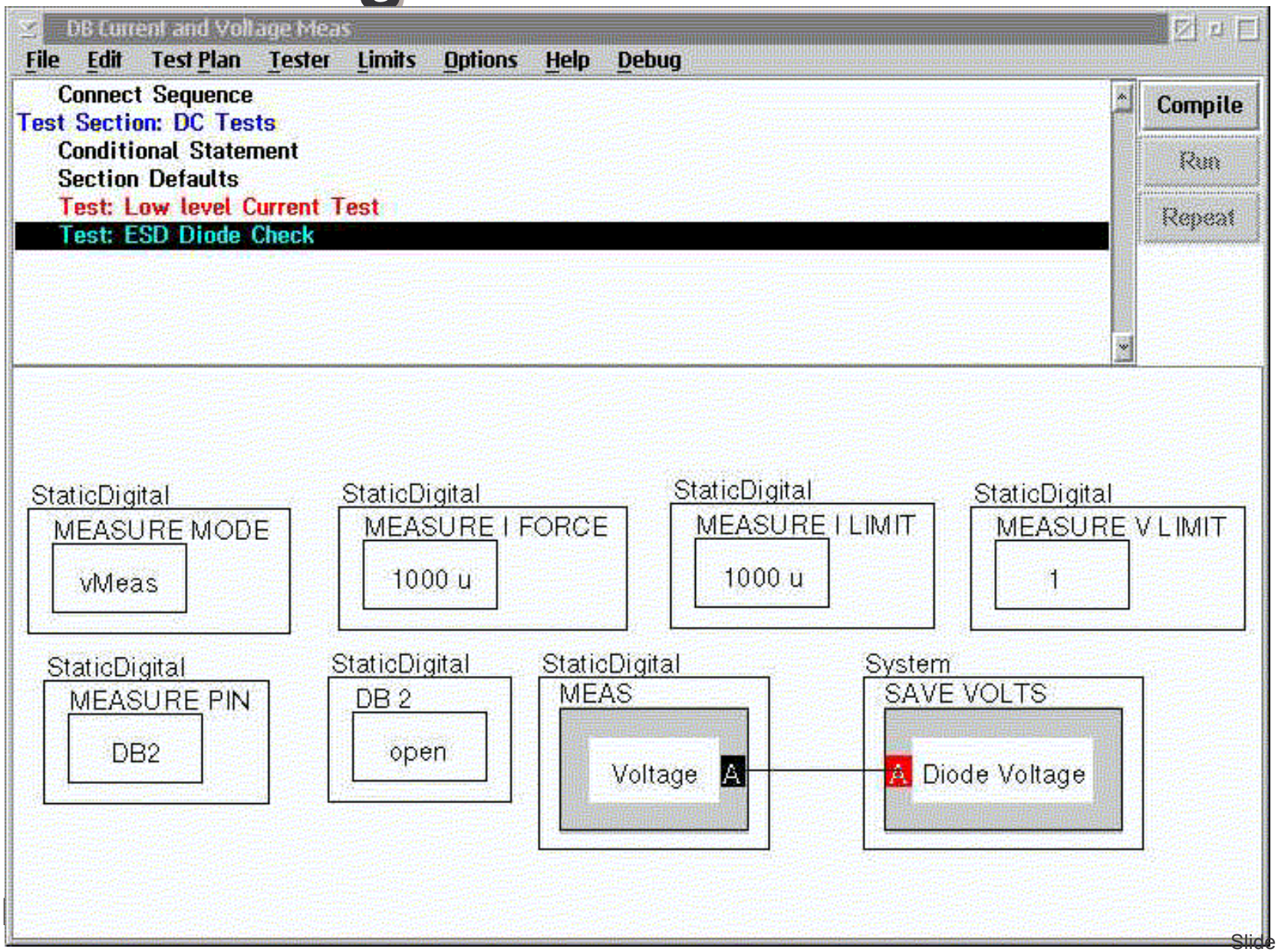
Measuring Leakage Current or ESD Diode Voltage with DB Lines

- Select voltage or current measure mode
- Set Opposing Limit (V or I Hard Limit)
- Set Measure Max. (sets Resolution)
- Set DB pin to Open
- Select DB pin to be Measured

Leakage Current Measurement



Diode Voltage Check



Source & Measurement Performance

- Absolute Power
- Relative Power
- S parameters (Amplitude and Phase)
- Noise Figure
- Phase Noise
- Baseband (Amplitude and Phase)
- Oscope/Digitizer Measurements
- DC Voltage and Current

Production Testing
Typical Performance

DUT	Measurement	Performance
LNA	Noise Figure	<1.0 dB
IPA	CDMA ACPR1	<-60 dBc
	CDMA ACPR2	<-70 dBc
Mixer	Noise Floor	<-150 dBm/Hz

Production Testing
Typical Performance

DUT	Measurement	Performance
PLL/VCO	Phase Noise	<-115 dBc/Hz 100 kHz offset
Dividers	Frequency	<1 Hz resolution to 20 GHz

Production Testing
Typical Performance

DUT	Measurement	Performance
I/Q Mod	Phase Match	<0.1 degree
	Amplitude Match	<0.025%
	LO Rejection	<-60 dBs
	Image Rejection	<-70 dBs
I/Q Demod	Phase Match	<0.1 degree
	Amplitude Match	<0.1 dB

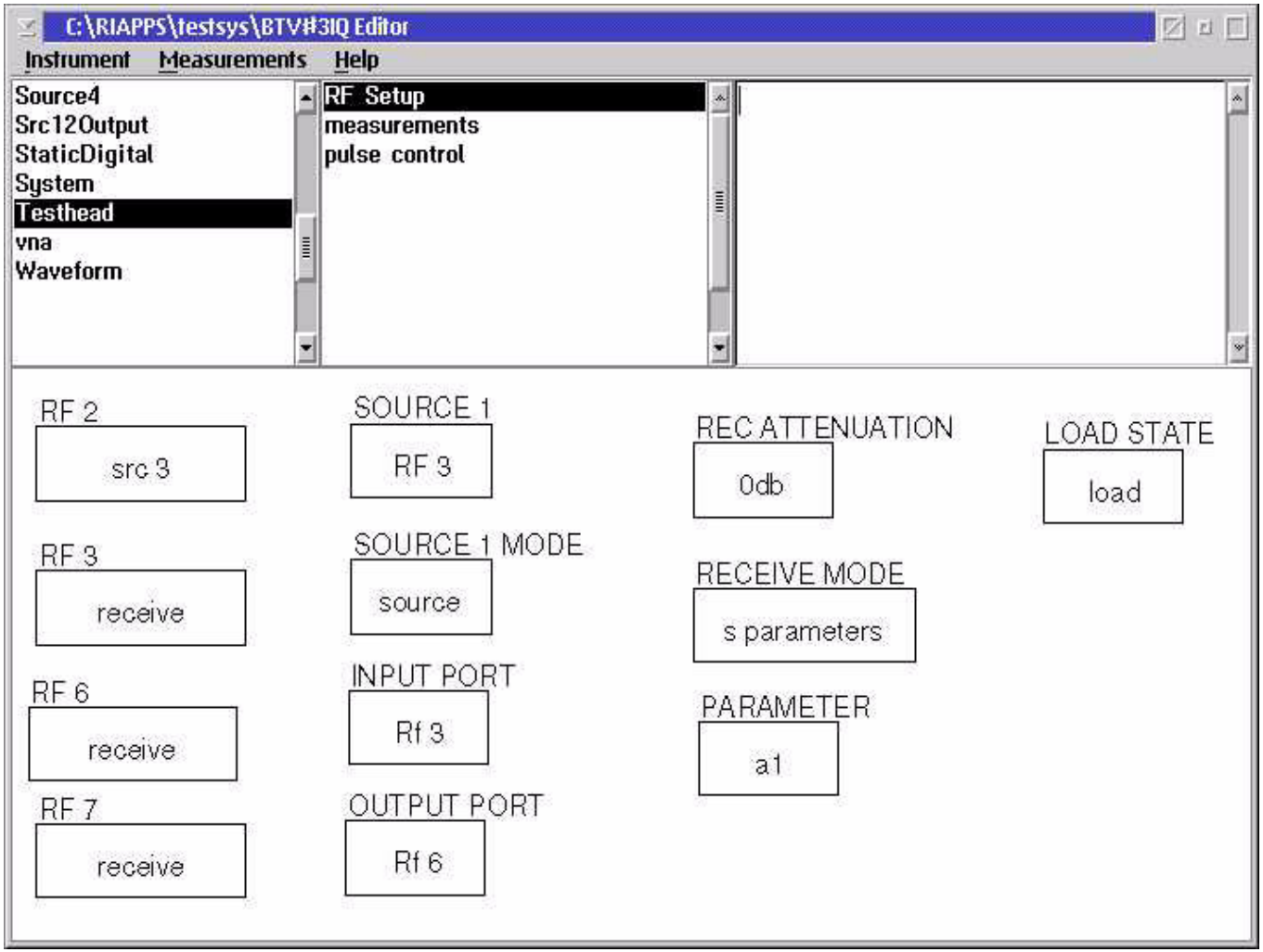
Selecting the Correct System Resource

- RF Resources
  RF 2, 3, 6 & 7, RF 4 & 5 and RF 8
- Base Band Resources
  WF 2 & 3, WF 6 & 7 and WF 8
- DC Resources
  VCC 1 - 6, DP 1 - 16, VI 1 - 3 &
  VM 1- 4 & 1N - 4N
- Digital Resources
  DB 1 - 8 and DB 9 - 16

Defining Device, Device Interface, Fixture & Tester Resources

- Start with the Device
- Device
- DUT Board & Device Interface
- Test Fixture
- Test Head
- Tester Resources

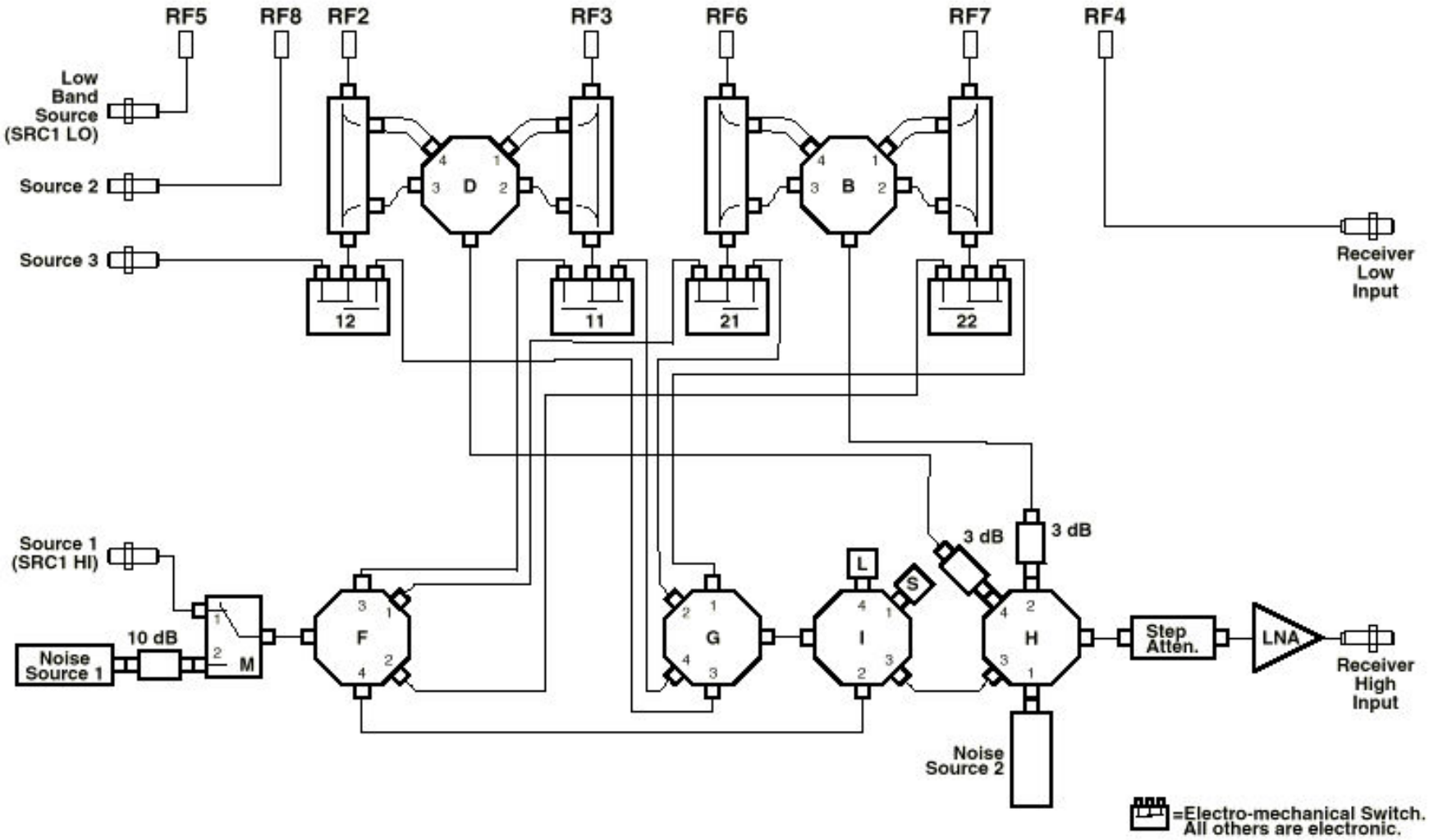
Testhead Set-Up



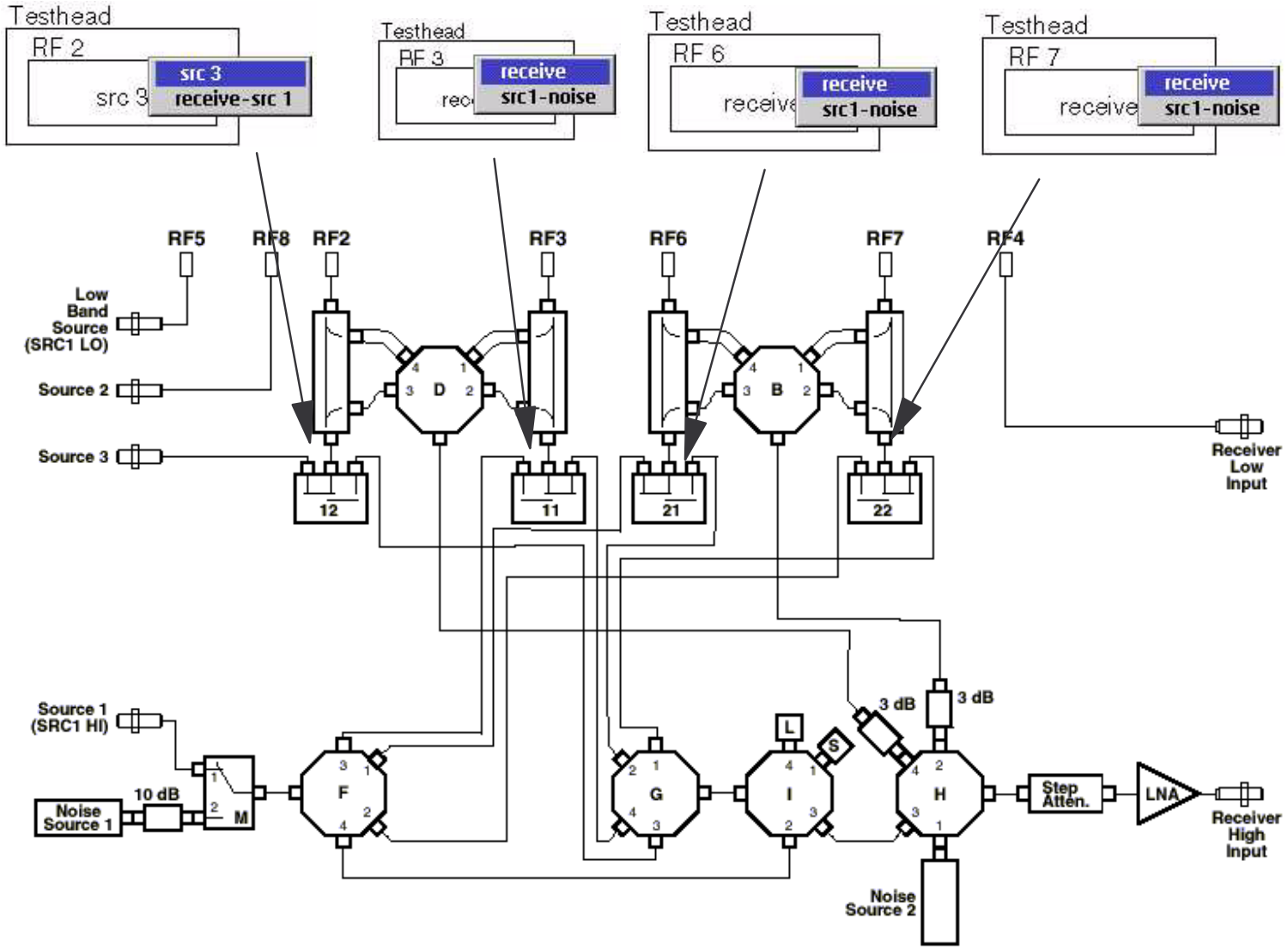
Roos Instruments, Inc - RI7100A

RF Block Diagram, Test Head

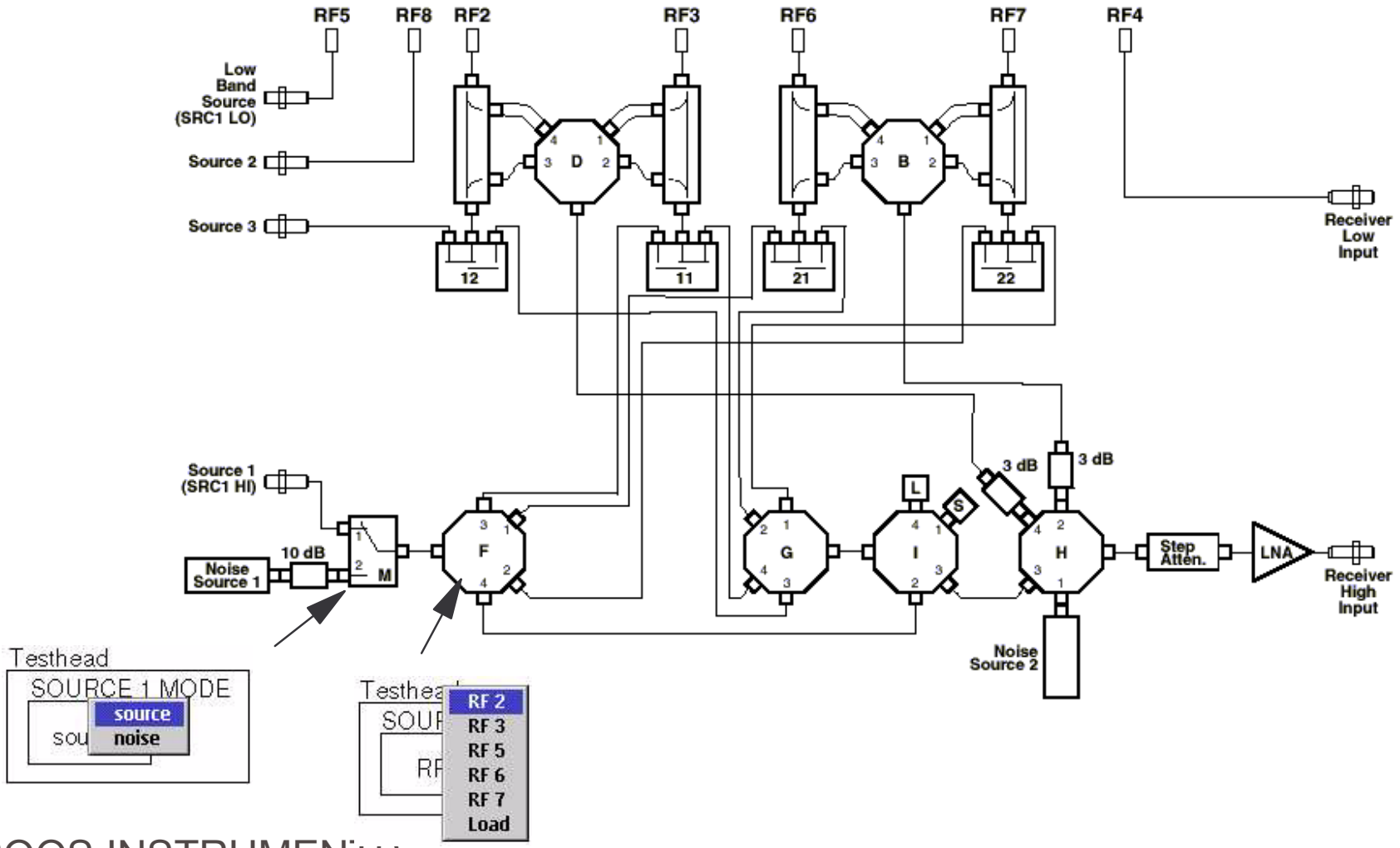
12/22/99



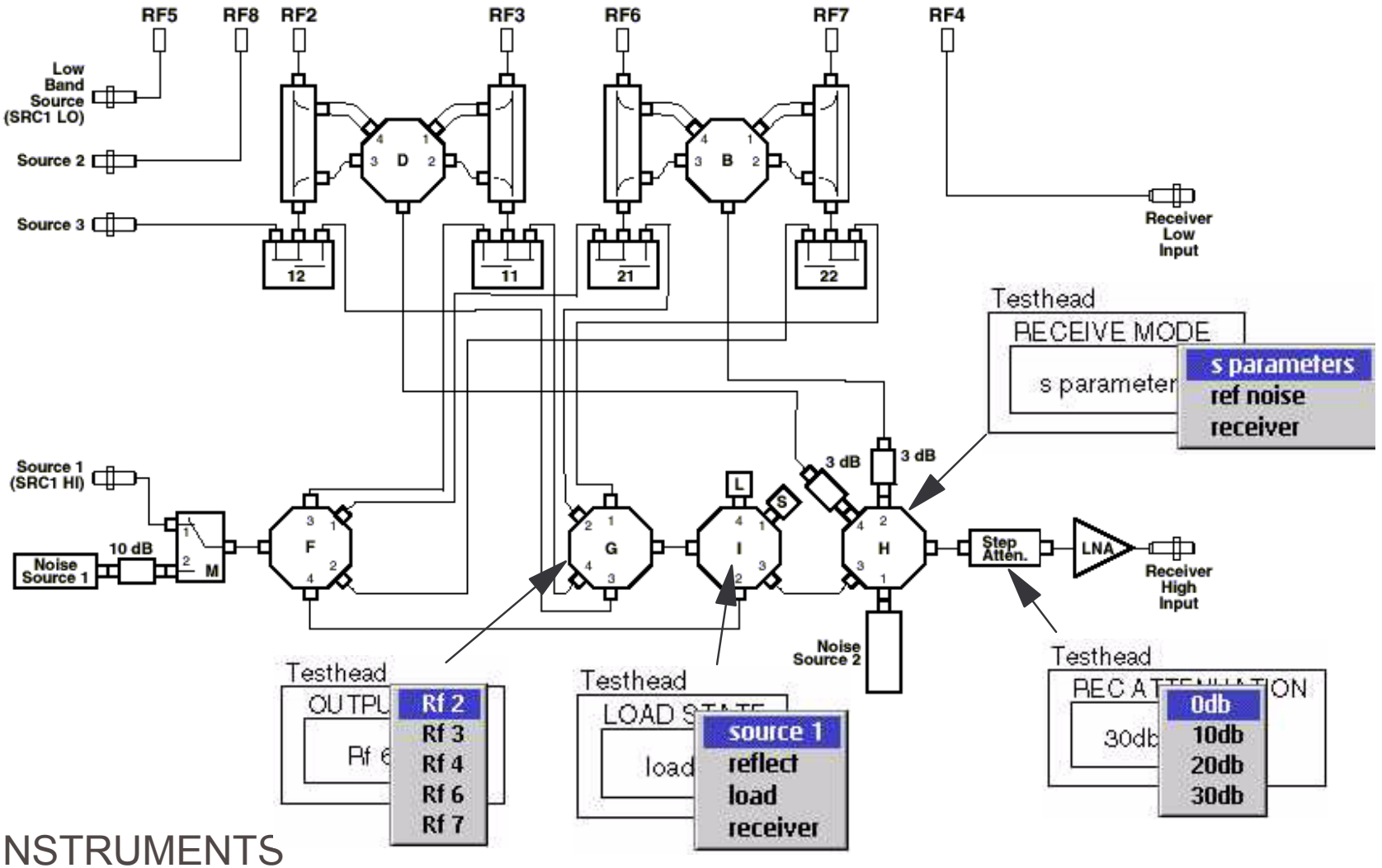
Port Set-Up


Testhead
RF 2
src 3
src 3
receive-src 1
Testhead
RF 3
rec
receive
src1-noise
Testhead
RF 6
receive
receive
src1-noise
Testhead
RF 7
receive
receive
src1-noise
RF5
RF8
RF2
RF3
RF6
RF7
RF4
Low Band Source (SRC1 LO)
Source 2
Source 3
D
B
12
11
21
22
Receiver Low Input
Source 1 (SRC1 HI)
10 dB
Noise Source 1
M
F
G
L
S
I
3 dB
3 dB
H
Step Atten.
LNA
Receiver High Input
Noise Source 2

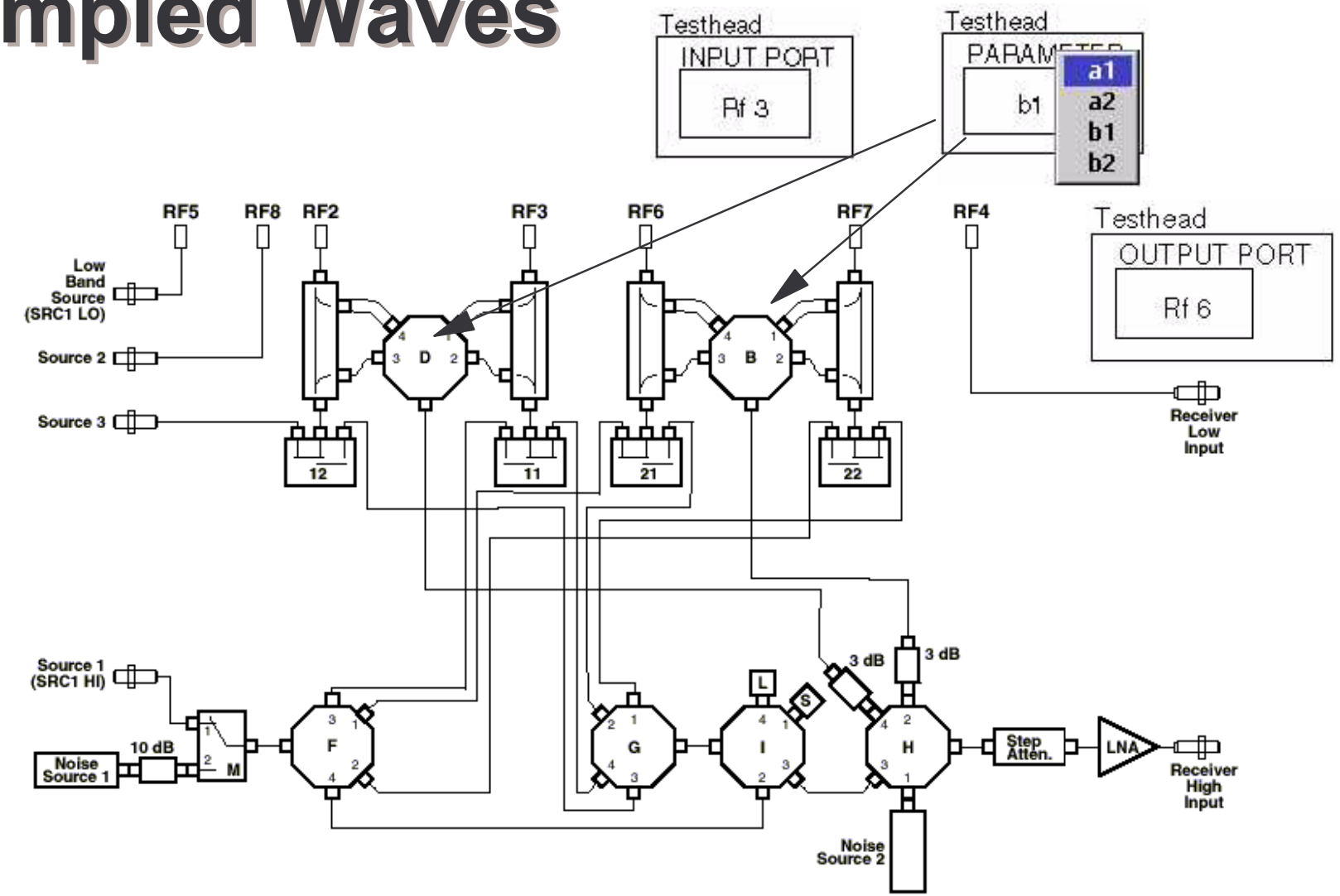
Stimulus


RF5
RF8
RF2
RF3
RF6
RF7
RF4
Low Band Source (SRC1 LO)
Source 2
Source 3
D
B
12
11
21
22
Receiver Low Input
Source 1 (SRC1 HI)
Noise Source 1
10 dB
M
F
G
I
H
L
S
3 dB
3 dB
Step Atten.
LNA
Receiver High Input
Noise Source 2
Testhead
SOURCE 1 MODE
source
noise
RF 2
RF 3
RF 5
RF 6
RF 7
Load

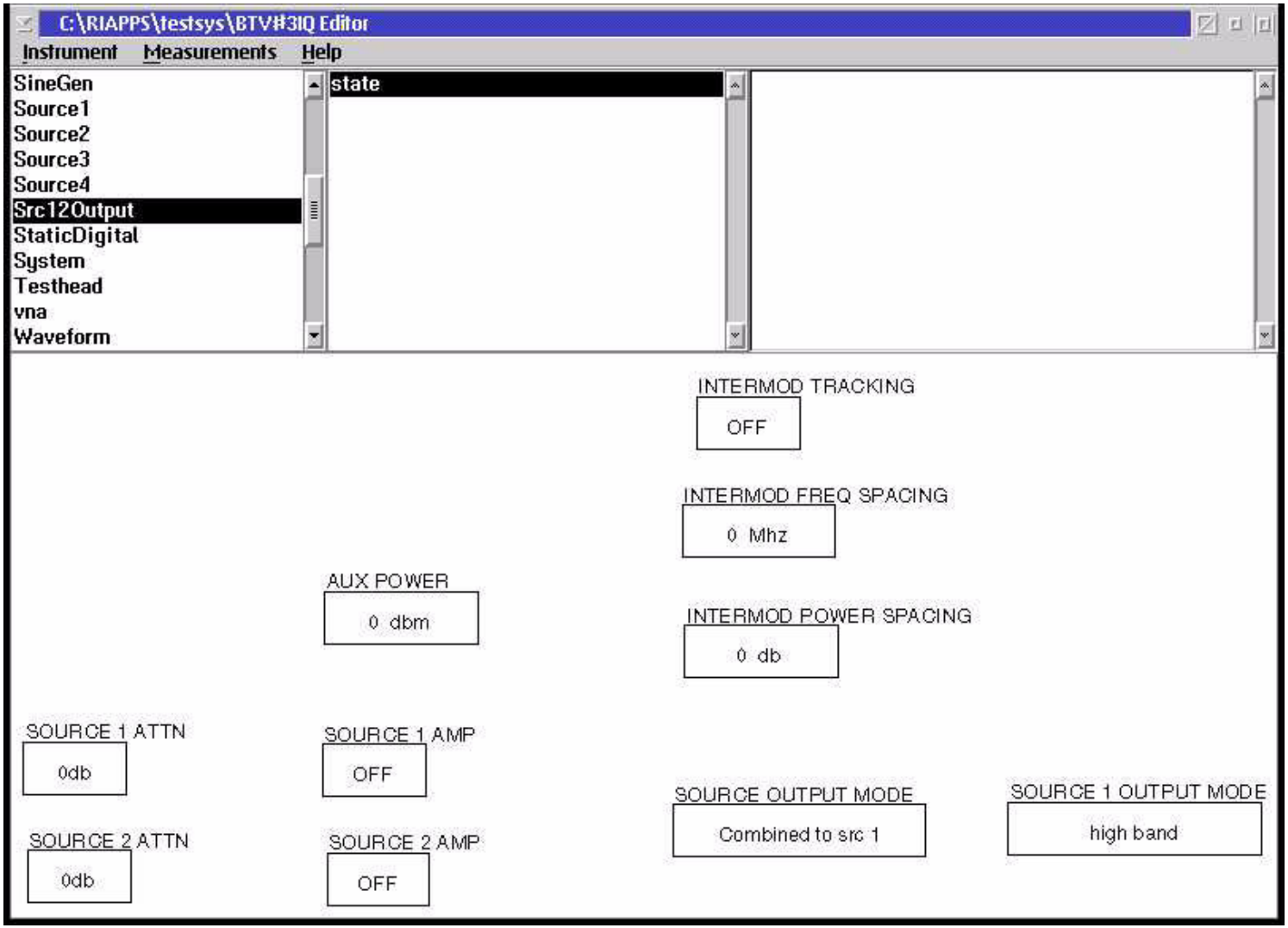
Receive


RF5
RF8
RF2
RF3
RF6
RF7
RF4
Low Band Source (SRC1 LO)
Source 2
Source 3
D
B
12
11
21
22
Receiver Low Input
Testhead
RECEIVE MODE
s parameter
s parameters
ref noise
receiver
Source 1 (SRC1 HI)
Noise Source 1
10 dB
M
F
G
I
H
L
S
3 dB
3 dB
Step Atten.
LNA
Receiver High Input
Noise Source 2
Testhead
OUTPU
Rf 6
Rf 2
Rf 3
Rf 4
Rf 6
Rf 7
Testhead
load
source 1
reflect
load
receiver
Testhead
30db
0db
10db
20db
30db

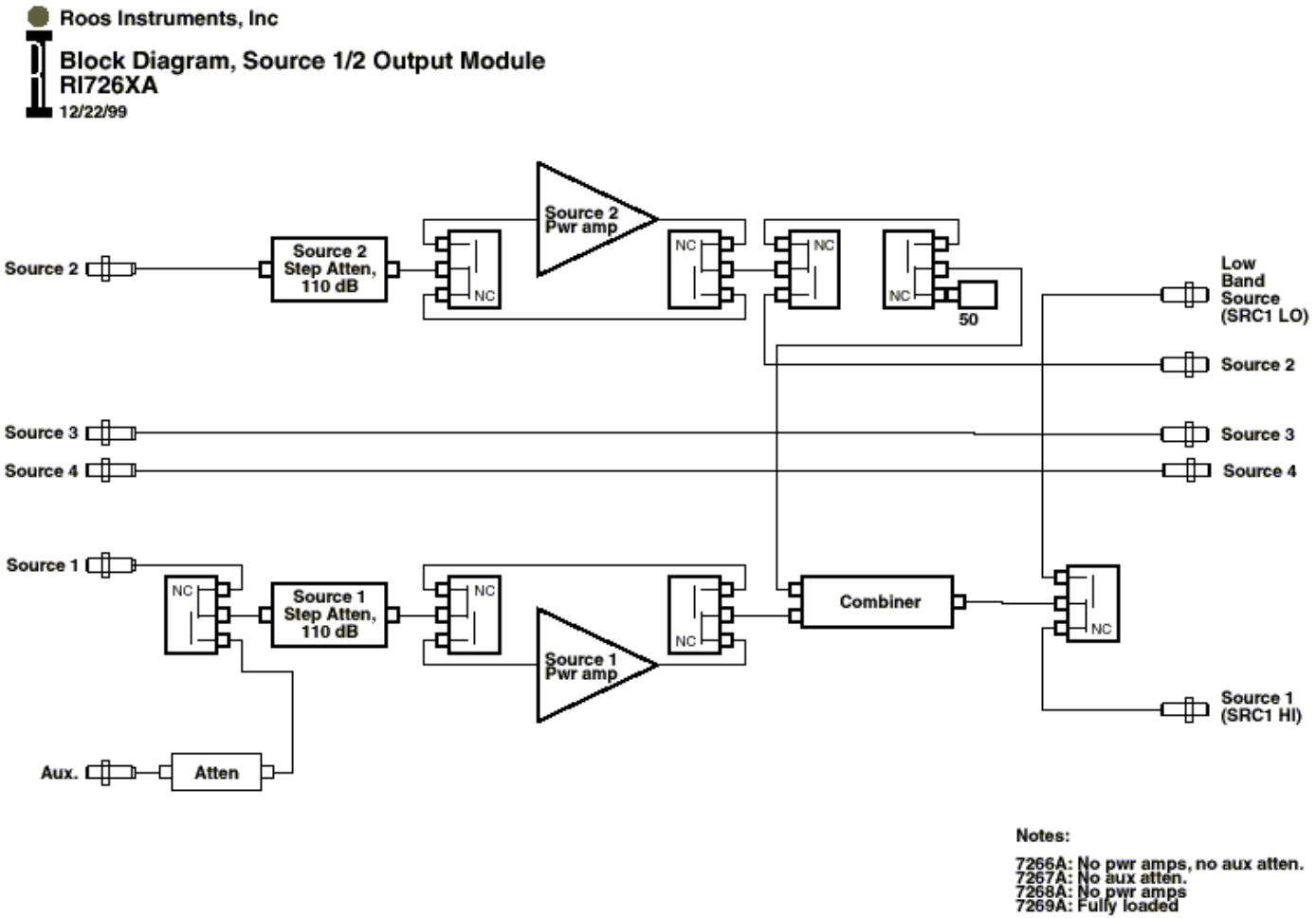
Sampled Waves



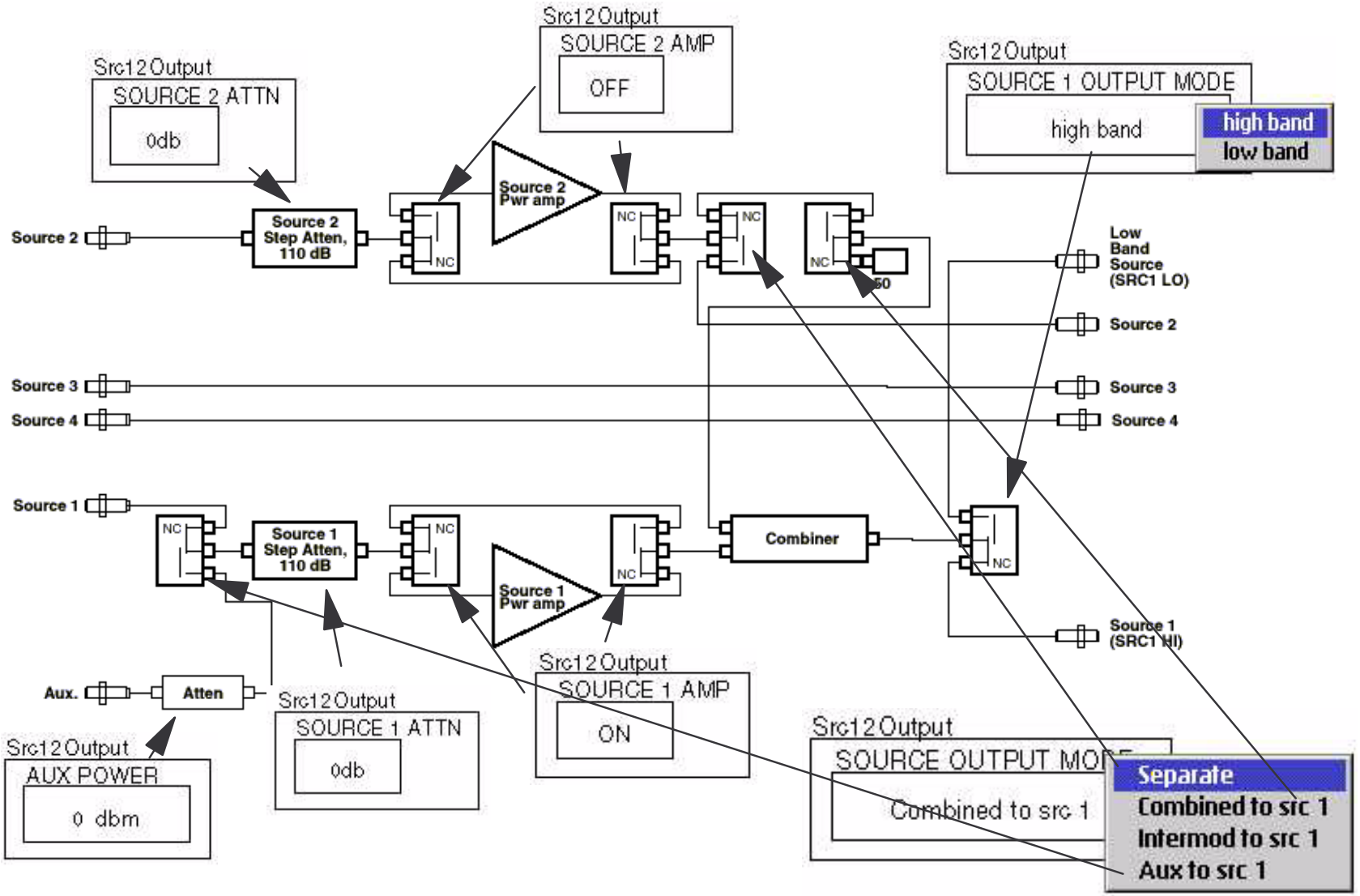
SRC12 Output



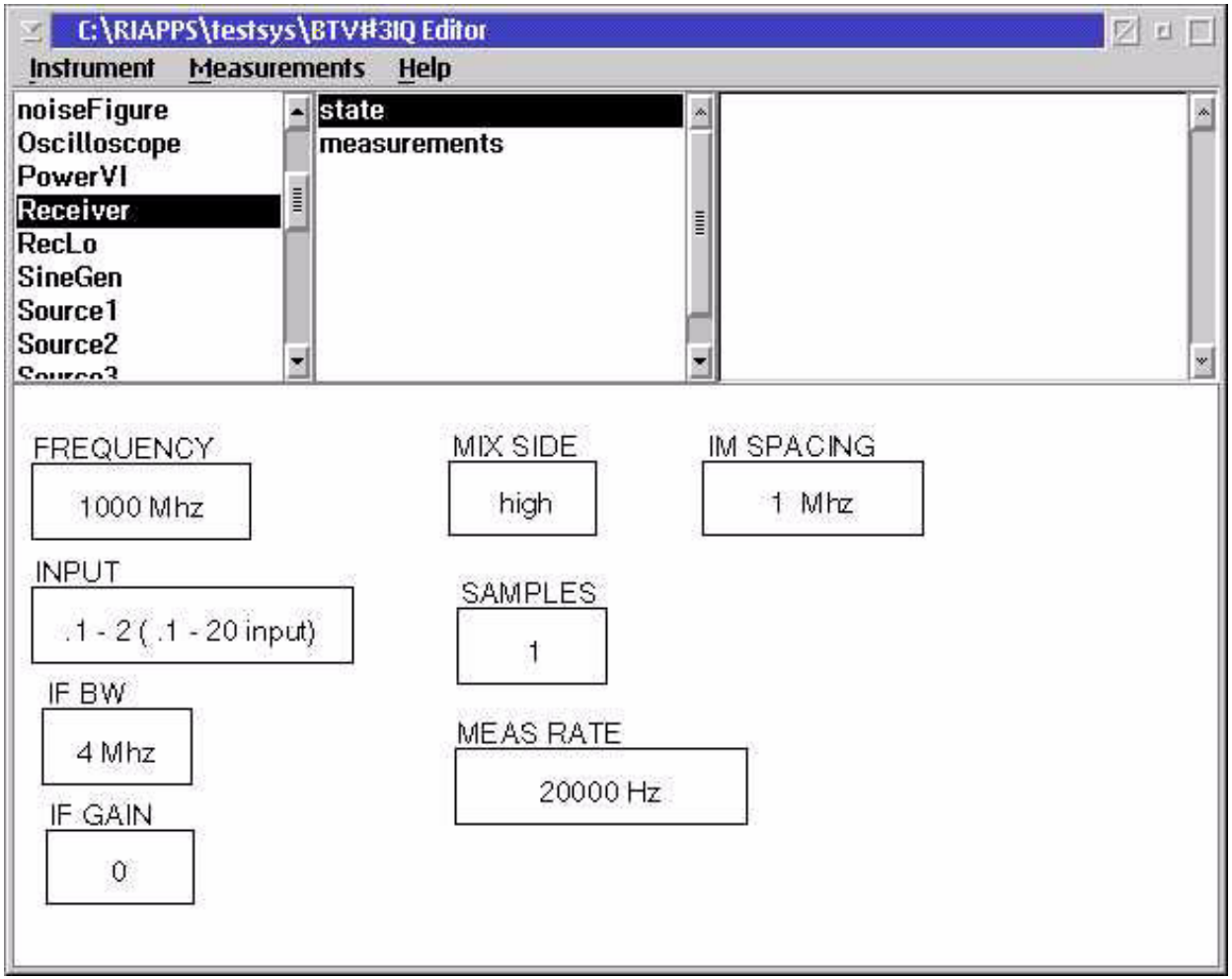
SRC12 Output



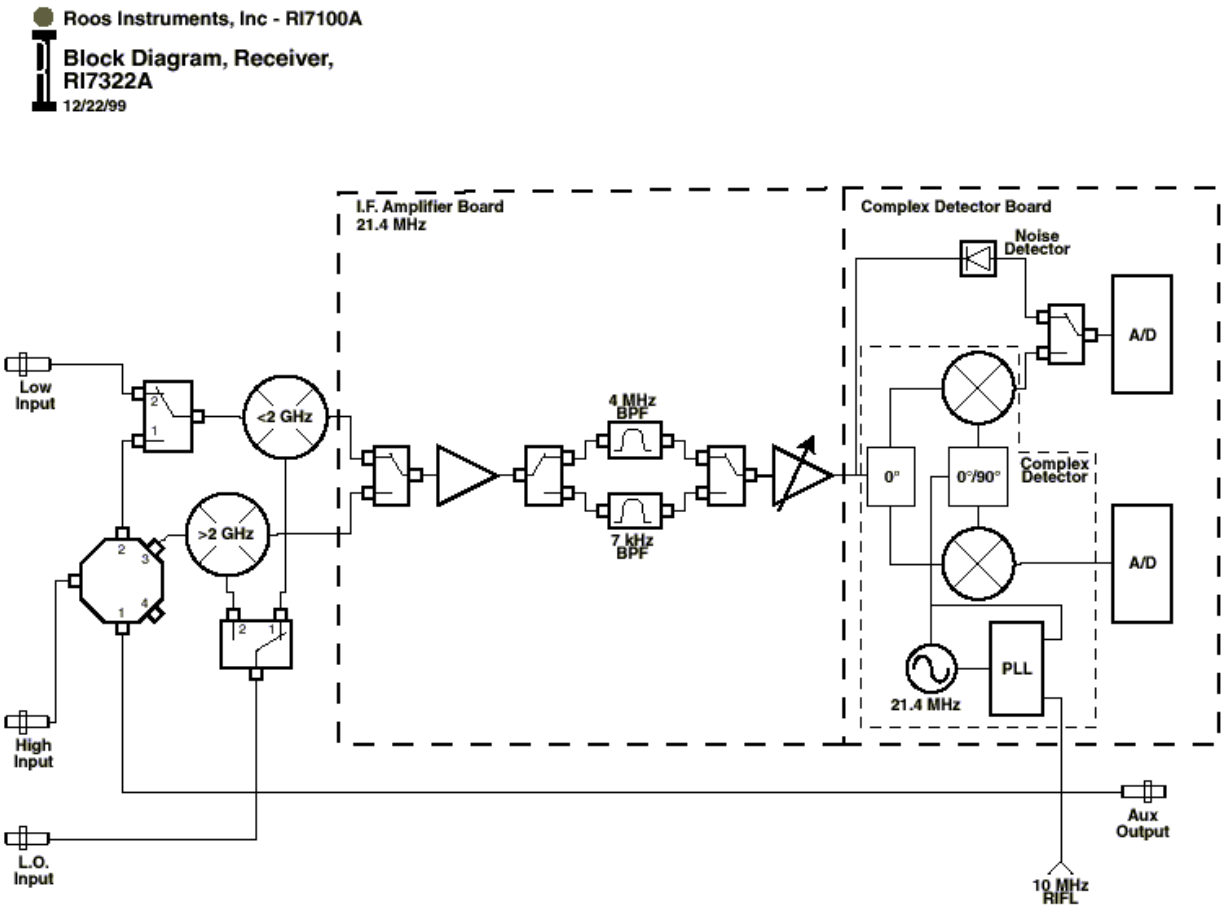
SRC12 Control



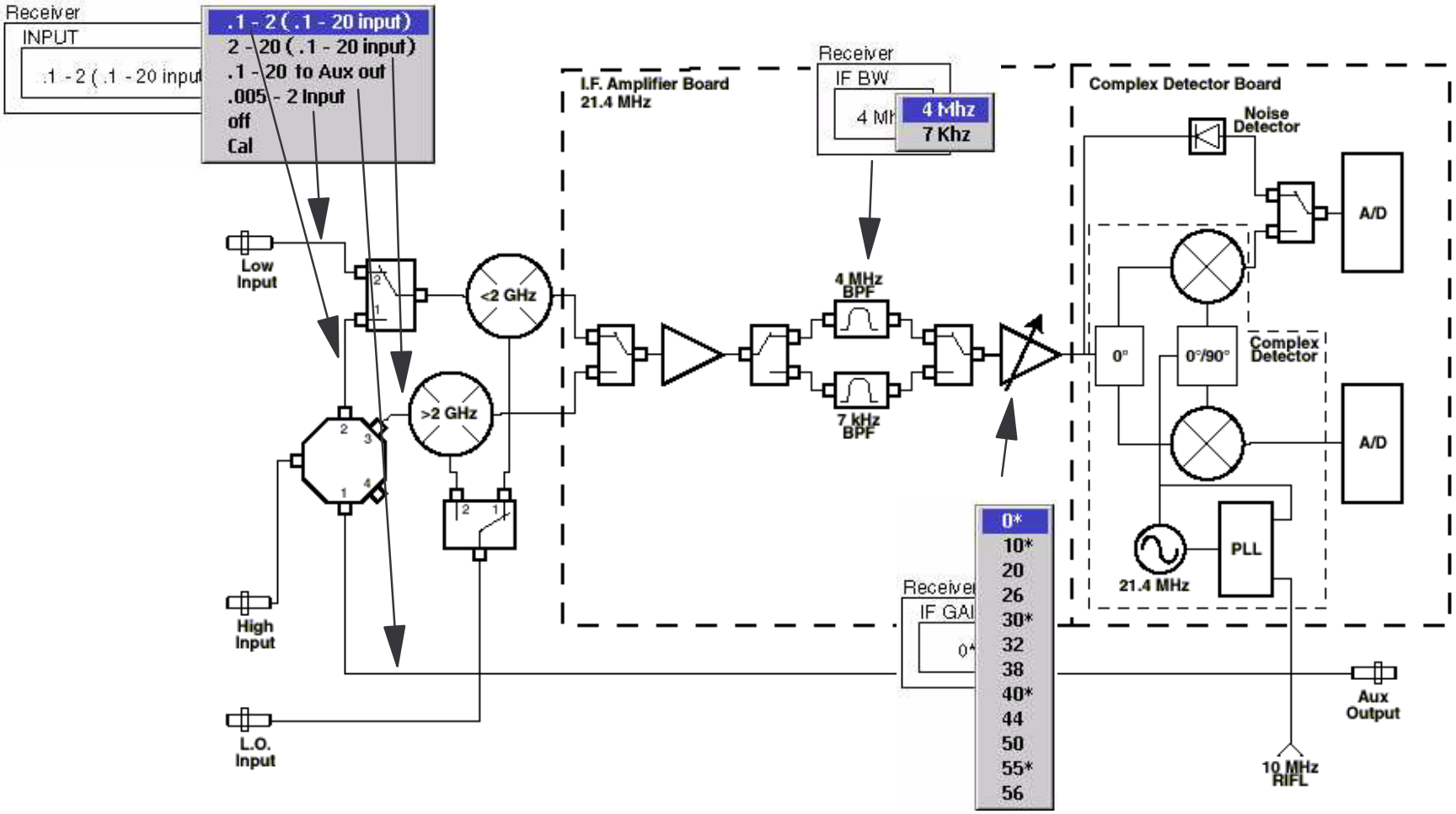
Receiver State



Receiver Block Diagram

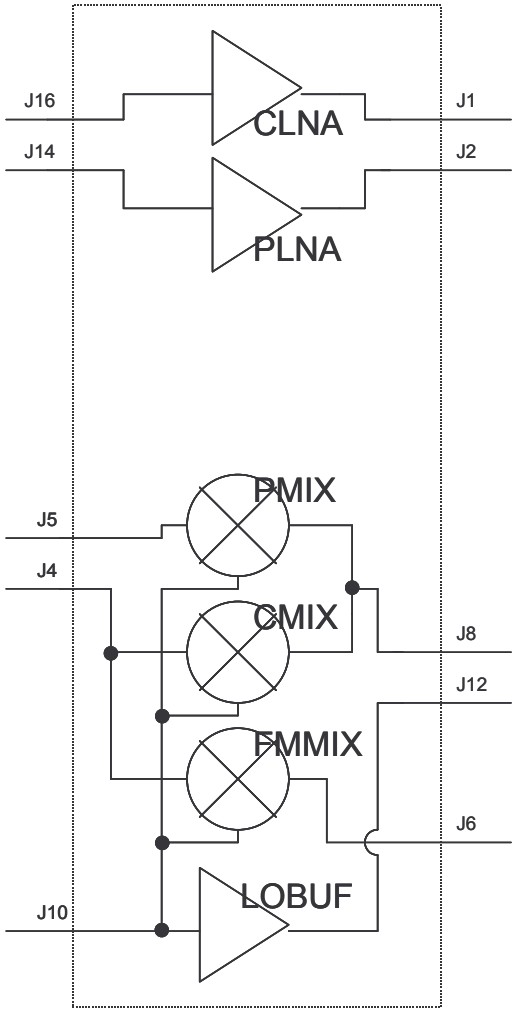


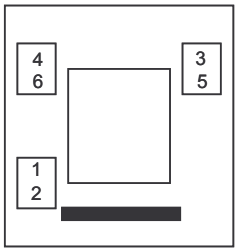
Receiver Control



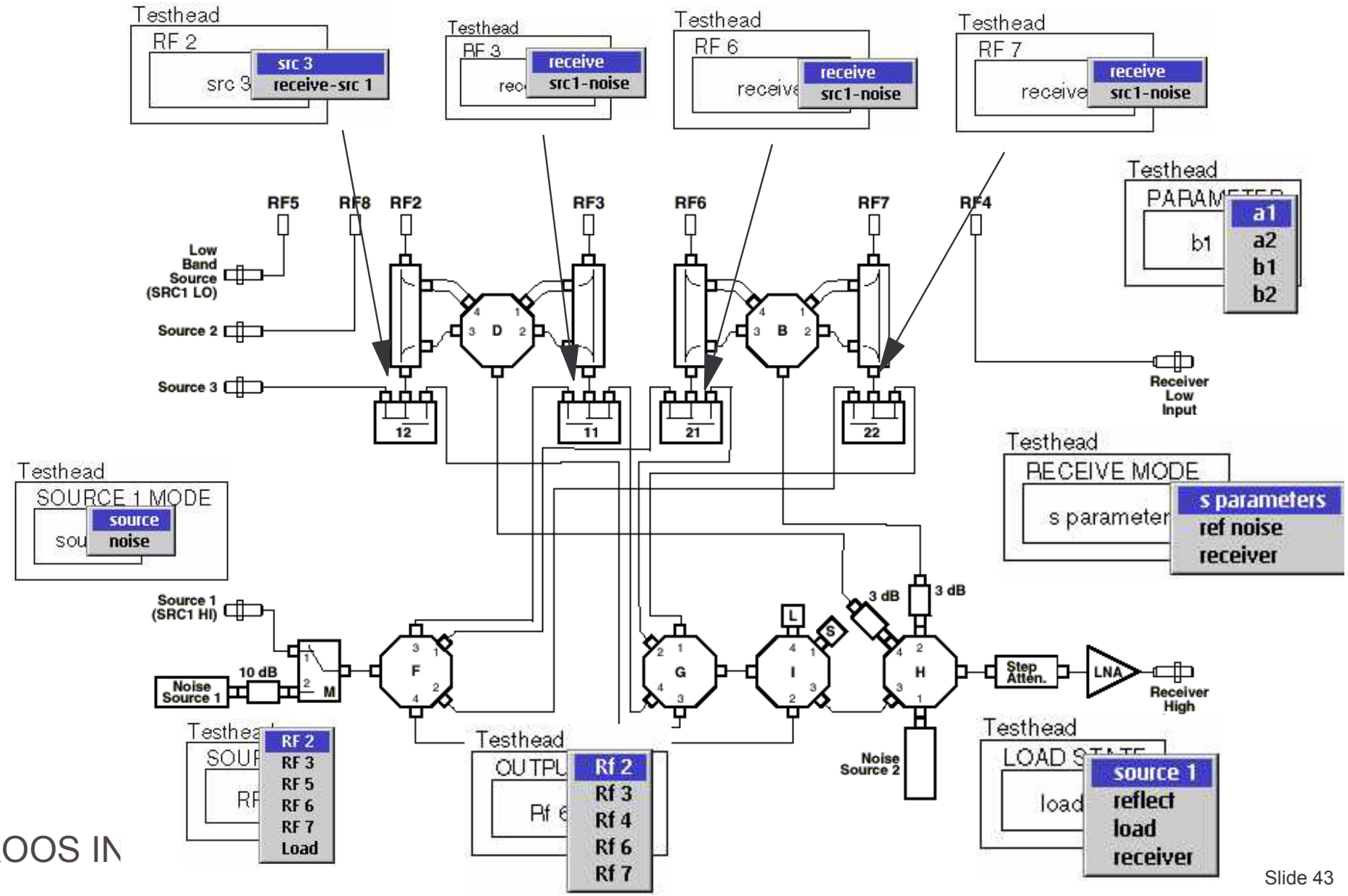
ROOS INSTRUMENTS

In Class Exercise - Define the Fixture & Tester Resources

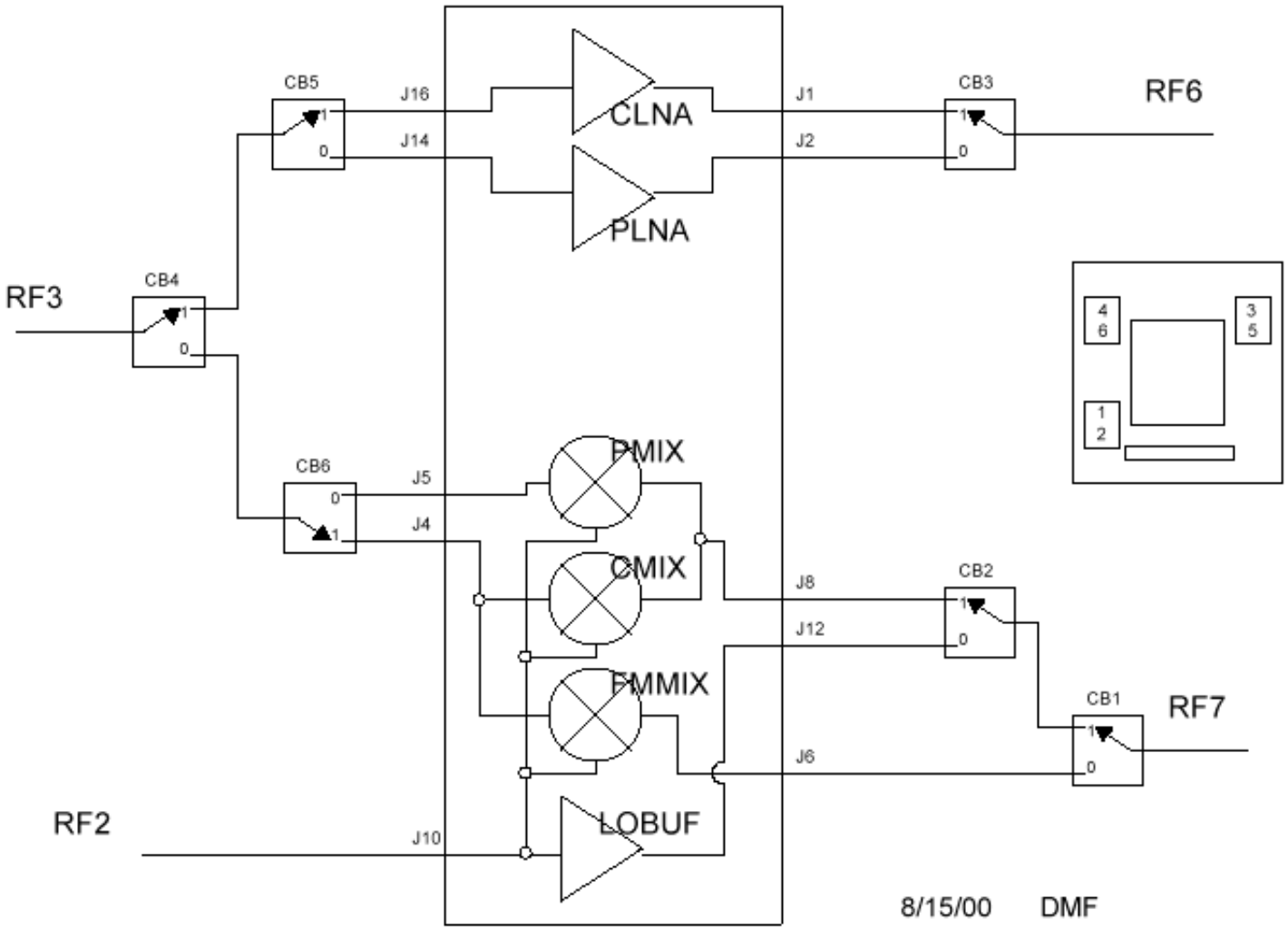




Class Example - Test Head Set-Up



Test Fixture Example



Test Plan - Comments, Guidelines and Suggestions

- Optimizer - Optimizes over Test Section
- Tester Viewer - Tester Reset Conditions
- Only add state buttons that are needed
- Changes cost time and money
- Data is displayed in the order listed & not displayed in the order performed
- Parameters set by LVs must be reset in the Disconnect Settings panel

Test Plan - Comments, Guidelines and Suggestions

- The tester is very fast changing state
- Your part may not be fast, add Pauses
- The tester will find unstable DUT states

Test Plan - Comments, Guidelines and Suggestions

- Fewer Test Sections better than more
- More simple test panels are better than fewer complex test panels
- Duplicate test states/conditions when ever possible
- Be consistent about where you place buttons in a test panel

Test Plan - Comments, Guidelines and Suggestions

- IMD Tests - more Receive Attn is better
- Noise Figure - Use 0 dB Rec Attn.
- Set DB Current Limit = DB I Meas Max.
- Set VI Current Limit ≥ VI I Meas Max.
- RF Sources - Optimum levels +/-5 dBm
- DMSG - Optimum levels <-5 dBm
- RF Off is <-30 dBm

Organizing Your Test Plan

- Define 1st RF state in Global Defaults
- Add Fixture ON to Global Defaults
- Define general test conditions in Section Default Panels
- Define DC tests in 1st or last Section which require the RF Sources to be off
- Define DC tests in 1st or last Section which require the DUT to be turned off

Organizing Your Test Plan

- Define special startup sequences in the Connect Sequence panel or in the 1st Test Section
- Write the tests in the order listed on your test list

In Class Exercise

- List different ways to Speed-up your Test Plan

Speeding-up Your Test Plan

VCC Changes & DC Measurements: < 2 msec.
RF Measurements: <30 msec.
RF Frequency Moves: <20 msec.
Switching RF Mechanical Switches: >30 msec. & Expensive
Minimize RF Source and Receiver Frequency Moves
Minimize/Eliminate RF Mechanical Switch Changes:
  Changing RF Ports from Source to Receive or Receive to Source
  Changing RF Source 1 and RF Source 2 RF Attenuators
Wide IF Filter Measurements are faster than Narrow IF Measurements
Typically use 16 or less Averages for RF Measurements
Typically use 32 or less Averages for DC Measurements
Fast RF Measurements: S parameters, RF Power and Phase
Slow RF Measurements: ACPR, Noise Figure, Intermods & Harmonics
Setting a Parameter to a Local Variable Value Requires a Mini-Compile

Speeding-up Your Test Plan

The Optimizer only Optimizes the Tests in a Test Section

Oscope vs. Receiver Measurements

- If the RF Receiver can make the Measurement, use the Receiver
- Receiver is faster with better Frequency Range & Dynamic Range
- Oscope is designed to measure Pulse Characteristics:
  - Rise/Fall Time, Period, Duty Cycle, etc.
- Receiver is designed to measure Complex Signals:
  - Amplitude, Phase, Noise, Power, Frequency, etc.

Items to Set in Global Defaults

- Receiver Frequency Tracking to Source 1 or System
- Test Head Parameter to b2
- RF Ports to Receive or Source
- Receiver IF Gain
- Source 1 Frequency & Level to first RF Stimulus Signal
- Source 2 Frequency & Level to the first IM Stimulus Signal
- Source 3 Frequency & Level to the first LO Stimulus Signal

Speeding-up Your Test Plan

Turning On and Off a RF Source is fast
Switching Source 1 Mode to Noise is faster!
Use Source 1 Mode button to Isolate Source 1 & 2 from DUT
Don't use Source 1 & 2 Attenuation to Isolate Source 1 & 2 from DUT
Use b1 to measure LO Leakage at the DUT's RF Input
Use Source 1 "back door" for S22 Measurements
Look at Compiled Delta Settings to Improve Test Speed
Look for changes in Receiver & Source Frequency, Attenuator & Test Head Settings, etc.
Minimize Test State changes by making test conditions exactly the same for as many measurements as possible including: RF Stimulus Levels, Frequencies, Receiver Settings, DC Levels, Current Limits, Ranges, Etc.
For IM measurements, leave RF Source 1 at the standard stimulus Frequency, this saves 2 RF Frequency Moves
Remember DC measurements set the Receiver and the RF Sources to their Default Frequencies